Assessing the Impact of Urban Development and Land Use Changes on Dhaka's Hazardous Air Quality

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INTRODUCTION

Dhaka, the capital of Bangladesh, is facing a critical environmental crisis with severely degraded air quality ranking among the top 5 globally in 2022, with an annual average PM2.5 concentration of 65.8 µg/m³, over 13 times the WHO guideline of 5 µg/m³. Rapid, unplanned urbanization, alongside major infrastructure projects like the Dhaka Metro Rail, Elevated Expressway, and Airport Terminal 3 expansion, has drastically altered the city's land use and land cover (LULC), increasing impervious surfaces, reducing green spaces, and intensifying construction related emissions. Comparative assessments of AQI data before and after major project completions could reveal a consistent pattern of deteriorating air quality, with construction phases correlating to temporary spikes in PM2.5 concentrations.

This study examines the impacts of urban development and LULC changes on Dhaka's air quality from 2017 to 2023 by integrating AQI data with geospatial LULC analyses. Understanding these interactions is critical for developing sustainable urban planning and air quality management in world's most densely populated megacity.

STUDY AREA

The study focuses on Dhaka District, Bangladesh, a major urban center experiencing rapid land use transformation driven by large-scale infrastructure developments. It covers approximately 1,464 square kilometers and serves as the administrative and economic hub of the country. The map delineates administrative boundaries, along with the project locations assessed in the study.
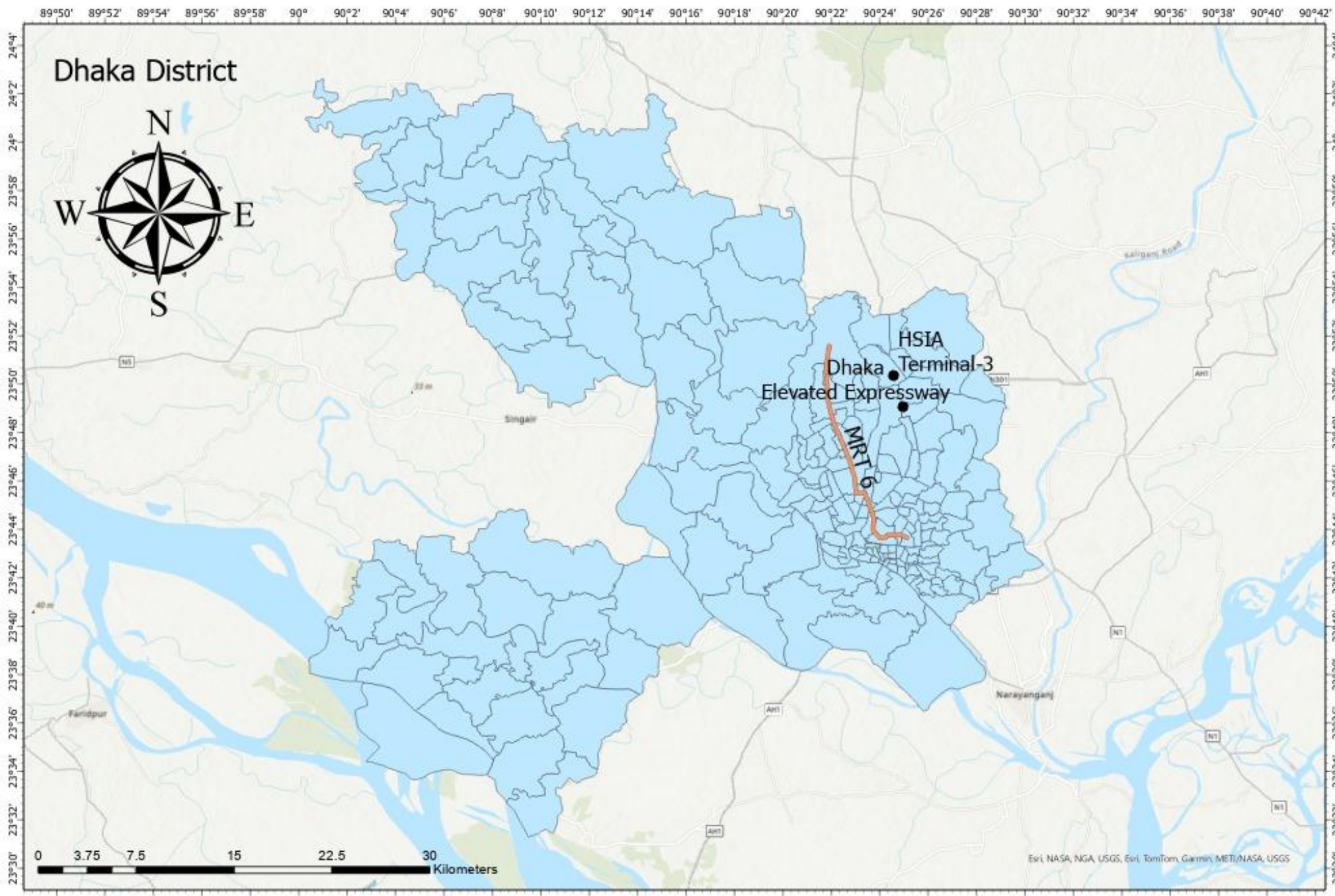

Study Area Map (Dhaka District)

METHODOLOGY
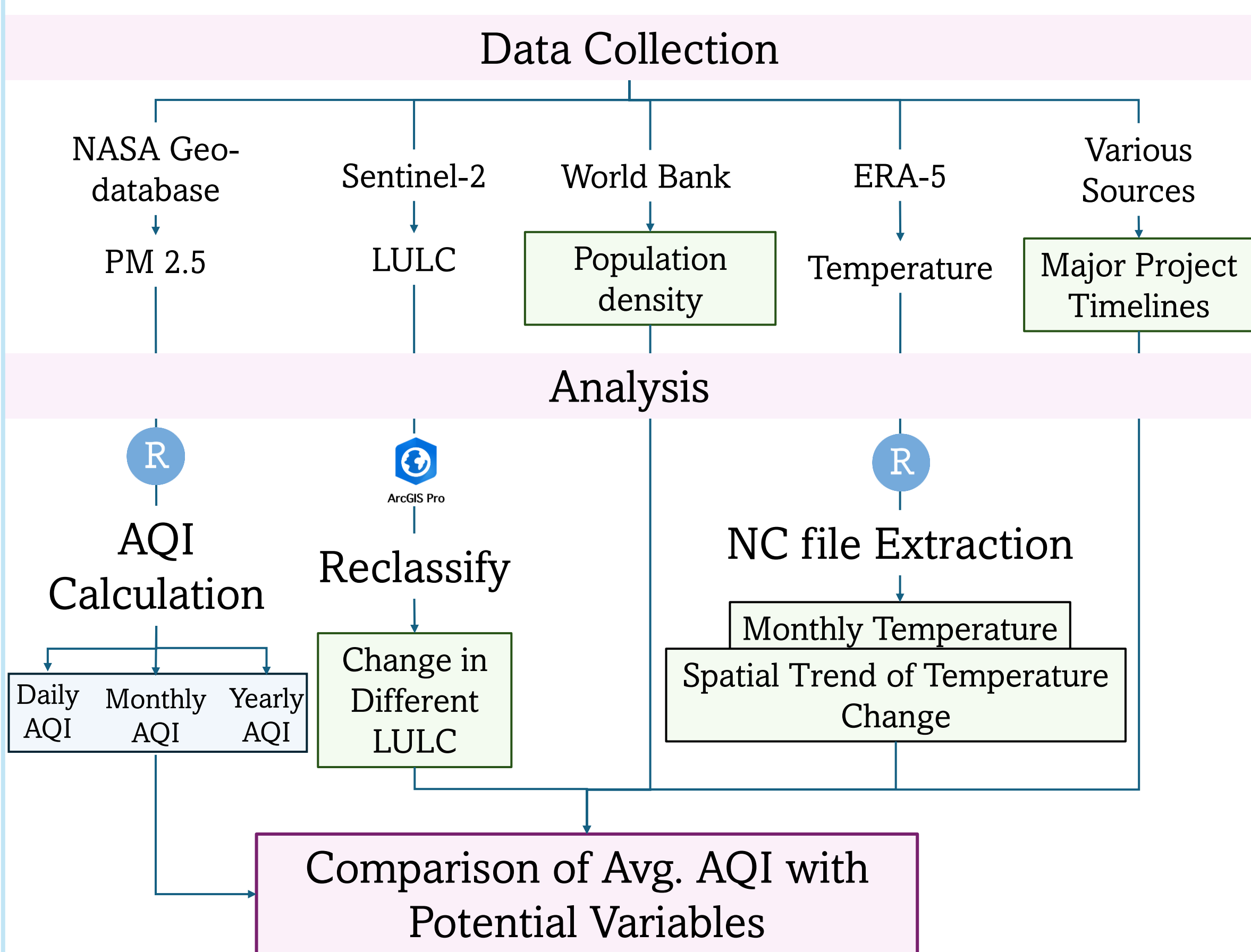
DISCUSSIONS

- AQI and PM 2.5 concentrations have shown a rising trend from 2017 to 2023.

- Average Daily AQI levels in Dhaka were never in good or healthy range in the study period (even during Covid lockdowns).

- Major infrastructure projects might have contributed to the deterioration of air quality.

- The significant drop in AQI during COVID-19 lockdowns highlights the urgent need for decentralizing professional activities across Dhaka.

- Rising temperatures are correlated to exacerbating AQI levels, signifying the need to assess the impacts of climate change in Air Quality.

- The concentration of workplaces and constructions in central Dhaka leads to overpopulation, driving land use and land cover (LULC) changes, thus mitigating the nature's ability to absorbing pollutants and directly contributing to worsening air quality.
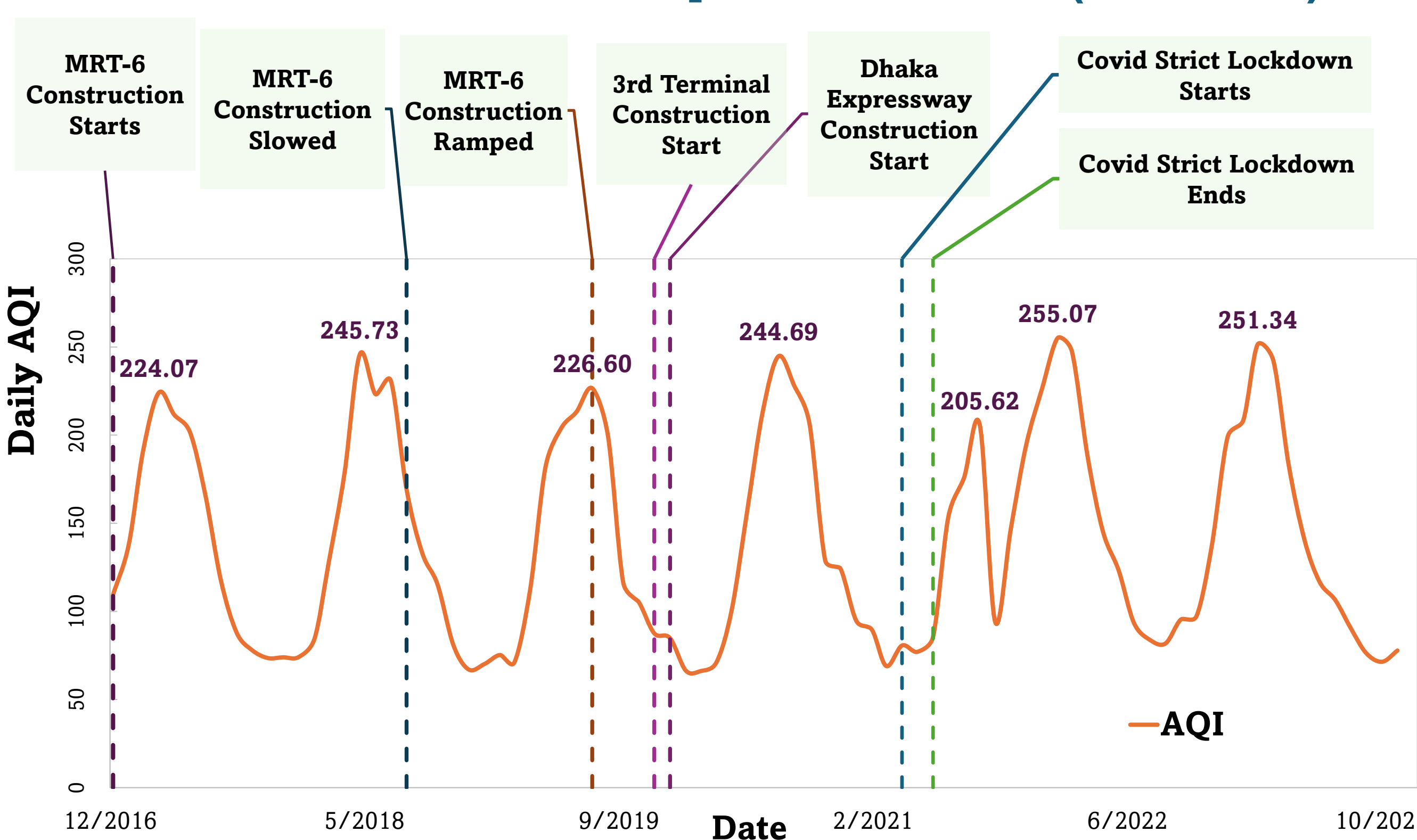
ANALYSIS & RESULTS

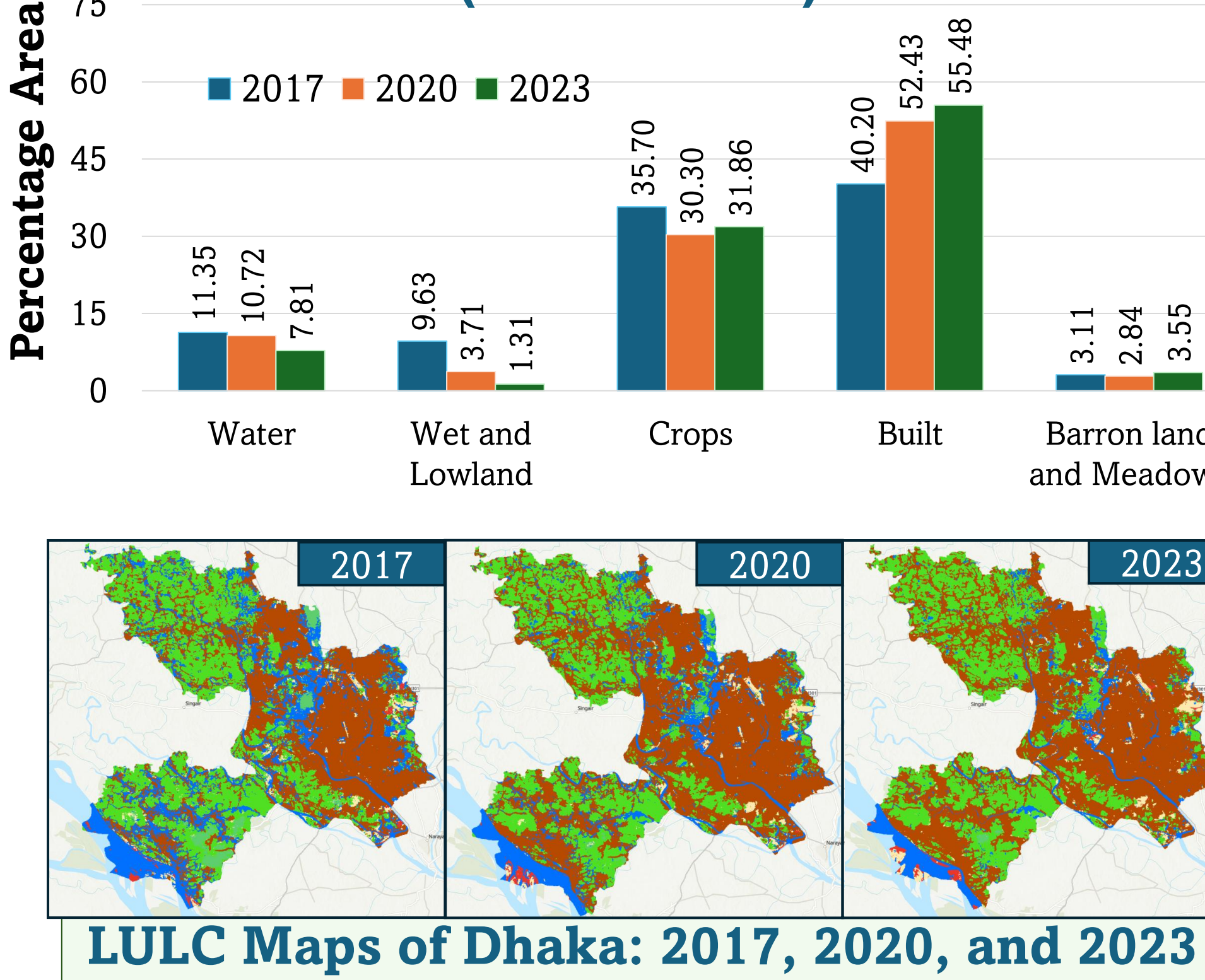**Daily Temporal Trends of PM2.5 Concentrations and AQI in Dhaka from 2017 to 2023**
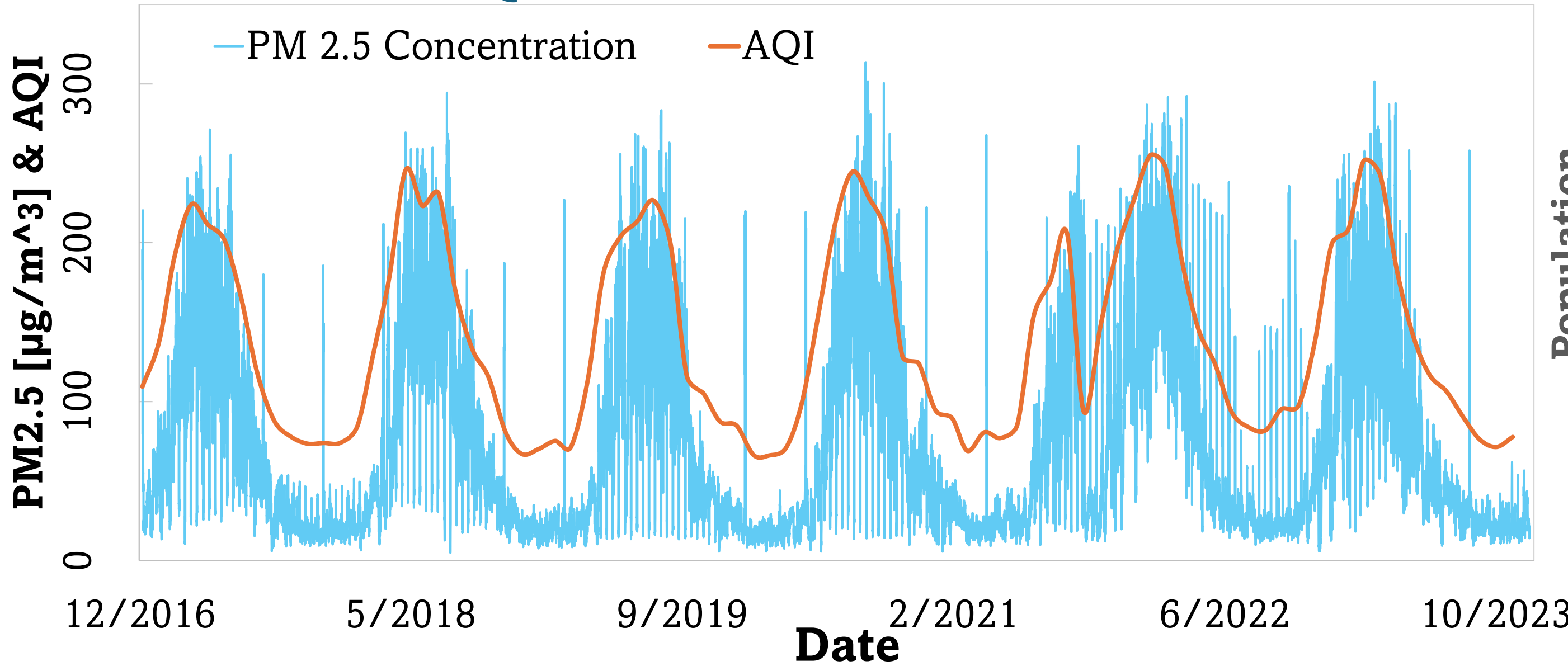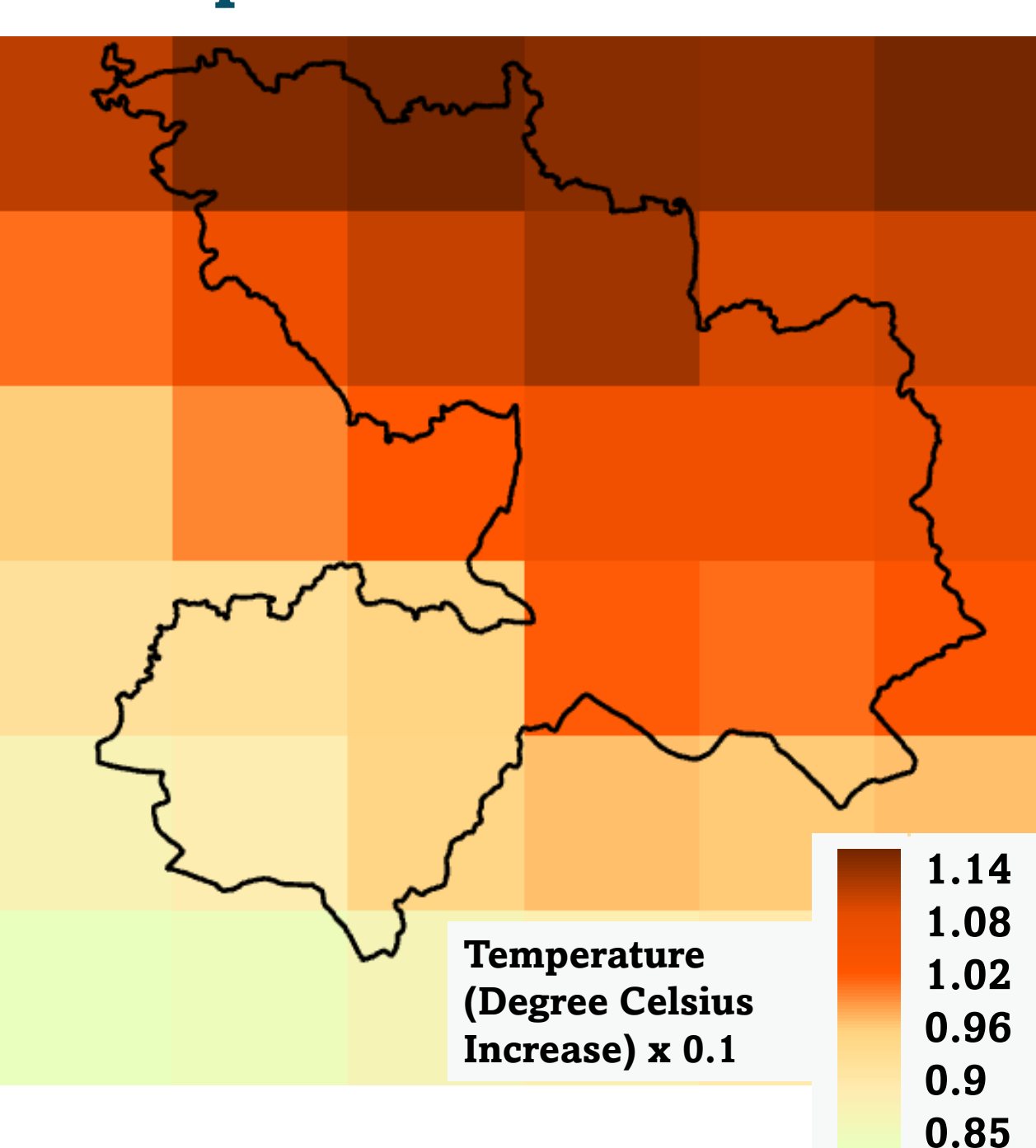

Yearly Average AQI vs Population
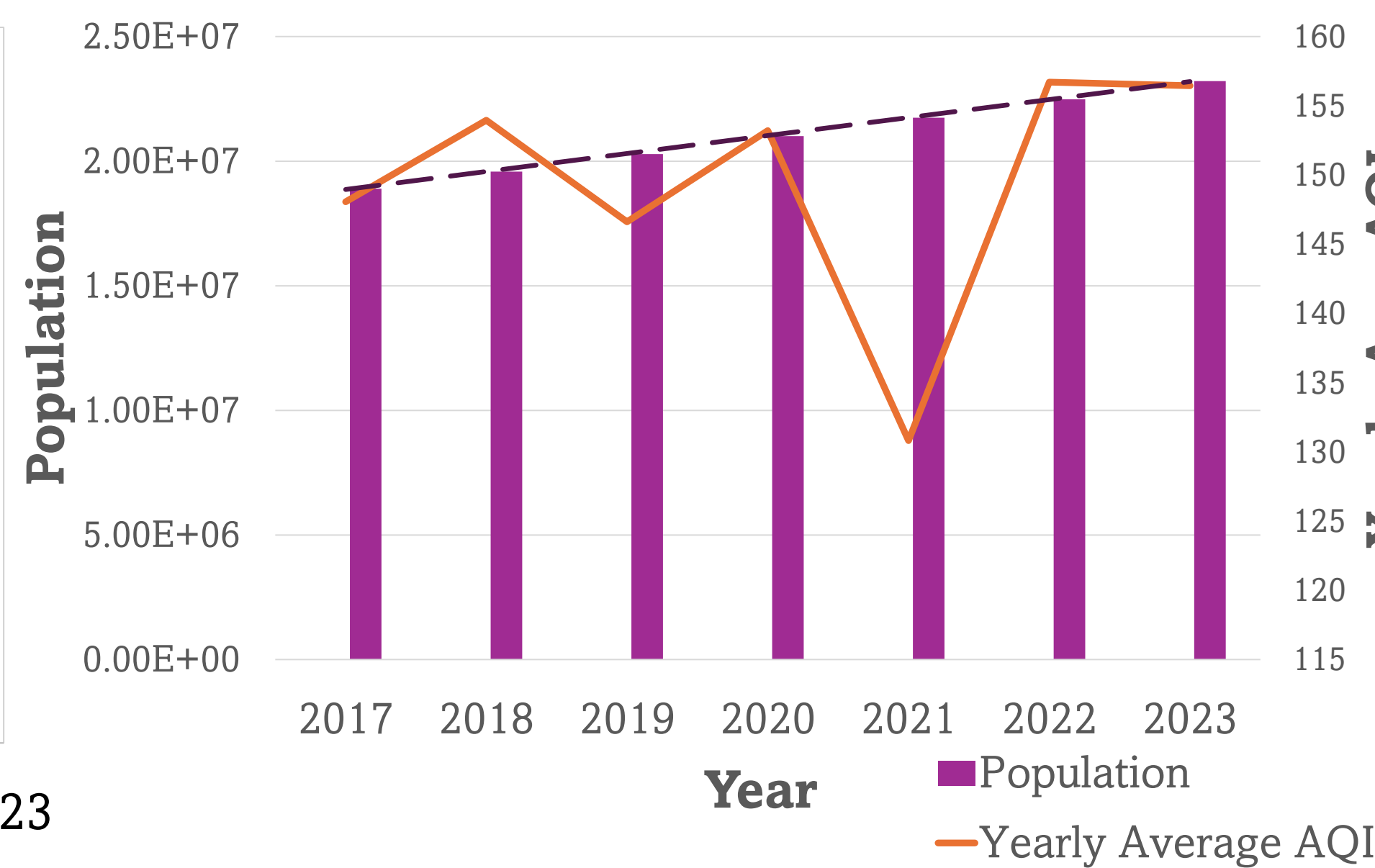
Temporal Variation of AQI and Timeline of Major Infrastructure Developments in Dhaka (2017-2023)
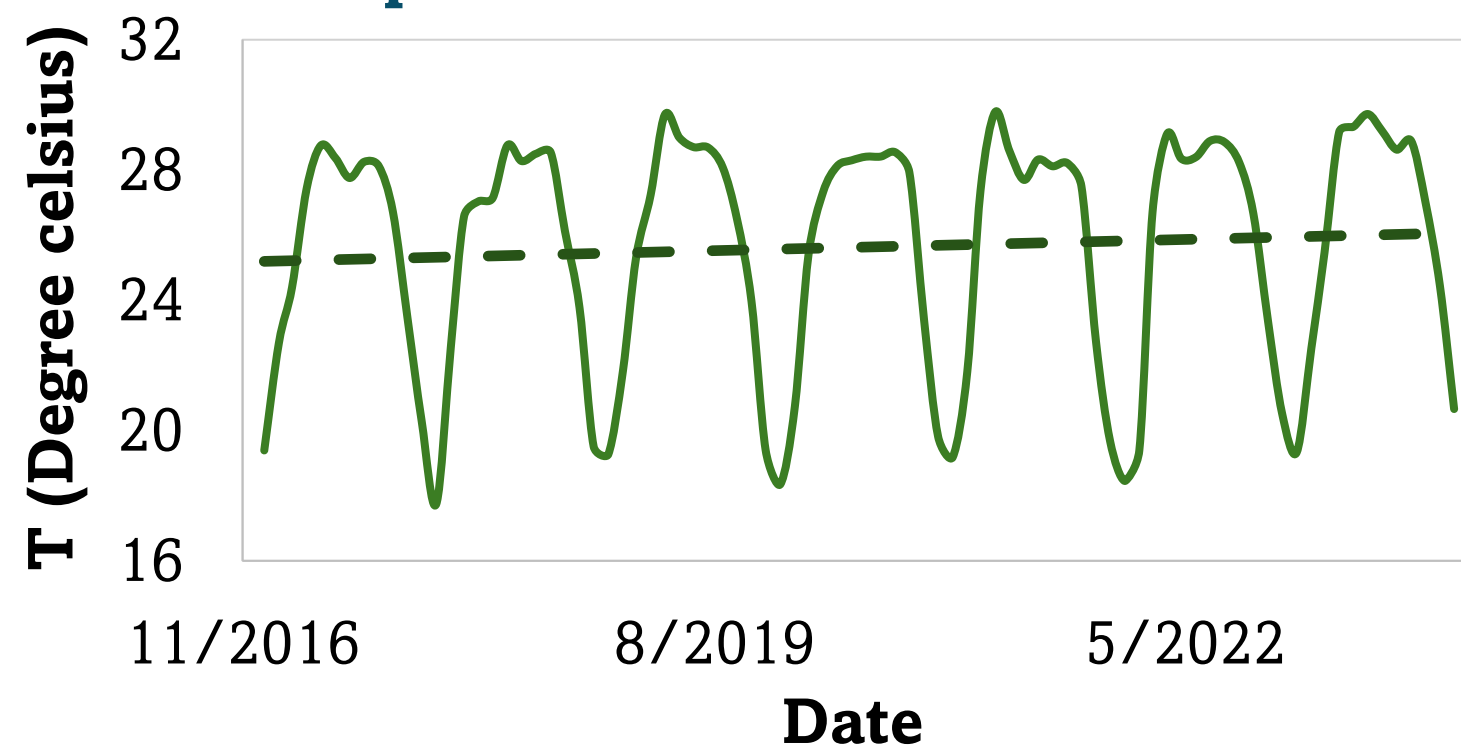

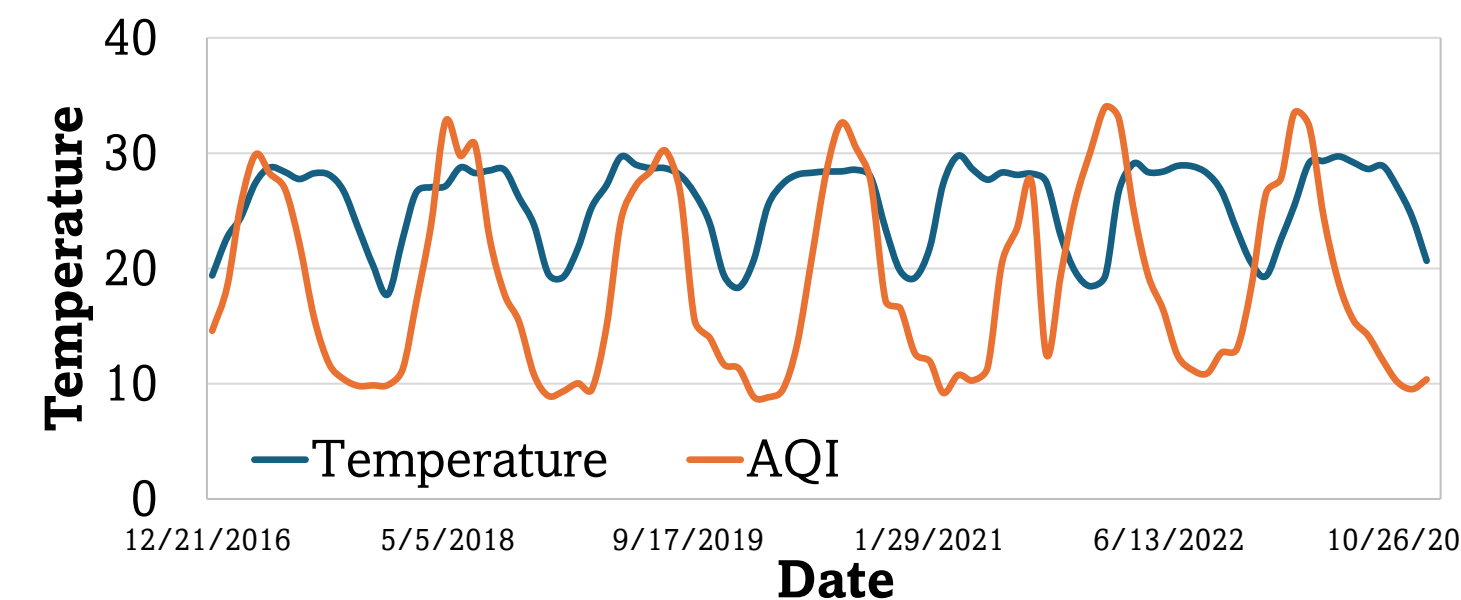**Temporal Changes of LULC in Dhaka (2017 to 2023)**

LULC Maps of Dhaka: 2017, 2020, and 2023

Spatial Distribution of Temperature Increase Rates

Temperature Trend From 2017 to 2023

Seasonal Patterns of Temperature and AQI

Relationship Between Temperature and Daily AQI with Air Quality Categories